Journal of the Royal Society of Western Australia, **71** (4), 1989, 99-100

Biotic and abiotic interactions in *Banksia* woodland

Byron Lamont

School of Biology, Curtin University of Technology, Perth WA 6001

Introduction

The aim of this synopsis is to explore interrelationships between representative plant species in banksia woodland and their environment. The two species selected are *Banksia menziesii* and *Adenanthos cygnorum*. Both are characteristic species of the Swan Coastal Plain, but extend further north on the coastal sands and, to a lesser extent, south-east in sandy pockets on the plateau (Nelson 1978, Taylor & Hopper 1988).

Banksia menziesii

This banksia flowers in winter, when few other species are available for nectar-dependent animals, especially honeyeaters (Newland & Wooller 1985). Florets open in response to foraging by honeyeaters (Ramsay 1988). These birds probably play a major role in pollen transfer as this species is self-incompatible (Scott 1980). There is minor consumption of pollen by staphylinid beetles (Ramsay 1988), while specialist moth and weevil larvae may feed on the flower heads (Scott 1982). Insect damage affects fruit set markedly. Cockatoos may feed on these larvae, giving some biological control (Cowling, Lamont & Pierce 1987, Lamont & van Leeuwen 1988).

Less than 1% of florets produce follicles, for various reasons (Fig. 1). A beetle larva feeds only on the seed of *B. menziesii* (Scott 1982). This banksia stores little seed in its canopy, although the proportion increases northwards, corresponding to an increase in likelihood of fires reaching the canopy to release the seed (Cowling & Lamont 1985). Otherwise, mature seed is released in late autumn. The seed and young seedlings are highly nutritious (S Holman & B Lamont unpubl) and are eaten by granivores and herbivores (Fig. 1; Whelan & Main 1979, Cowling & Lamont 1987). Seedling establishment is negligible in the absence of a post-fire seed bed, and rare even in its presence (Cowling & Lamont 1987). This is an evolutionary tradeoff with the ability of the parent plants to resprout after fire. The first summer drought plays a major role in seedling death, but there are other causes as well (Fig. 1).

Adult trees harbour many small animals, providing food and shelter, although there are no details in the literature (Fig. 1). Whole branches sometimes die and the loosened bark and dead wood are sources of food and shelter for additional small primary consumers, carnivores and parasitoids. *B. menziesii* is one of the few species susceptible to a minor disease which causes a coralloid distortion of the branches. The symptoms are consistent with invasion by a mycoplasm carried by cicadelloid leafhoppers, but the phenomenon has received no study.

The leaves drop after 4-5 years. The litter serves as food and shelter for decomposers but the rate of decomposition is extremely slow. Proteoid roots from the surface laterals grow up into the fresh litter. These hairy rootlets probably short-circuit the nutrient absorption path by adhering directly to the litter particles and promoting nutrient release (Lamont 1986). The proteoid roots mat the surface soil and increase its stability for geophytes and other small plants, but make inter-fire seedling establishment less likely. The sticknest ant, *Iridomyrmex conifer*, uses the litter for nest-building and is a major 'robber' of banksia nectar - it is believed to site its nest near nectar-rich trees (R P MacMillan, pers comm).

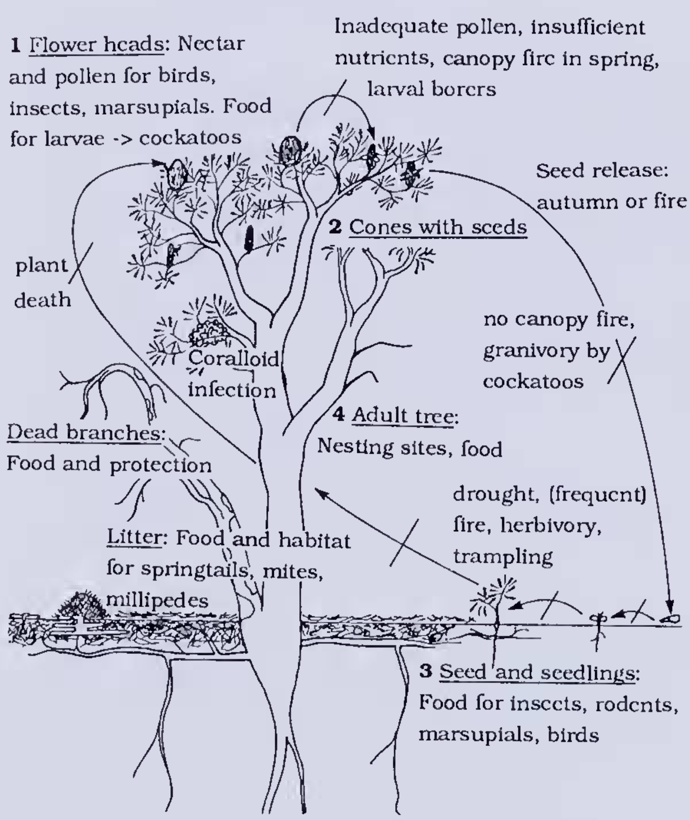

Figure 1 Interactions between *Banksia menziesii* and other components of banksia woodland on the Swan Coastal Plain. Line through arrow refers to inhibition of the process.

Adenanthos cygnorum

The woolly bush has many unusual features which give it a special place in the ecology of the region. It is a colonizer of soil- and fire-disturbed sites, growing as a thicket. This species is the tallest shrub and yet one of the few to be killed by fire. Unlike *B. menziesii*, the woolly bush flowers from spring to autumn, and has a major role in maintaining resident nectar-feeding birds throughout the year (Newland & Wooller 1985). The single flower is immersed in a terminal whorl of leaflets whose overlapping hairs, together with the constricted neck of the perianth, prevent access to nectar-robbing ants (Fig. 2). About 1-3% of the flowers are converted to fruits whose fate may follow three paths: (a) The green fruit is eaten by parrots on the plant. (b) The bracts surrounding the fruit open out pushing the leaflets into a cup from which the fruit drops to the ground (Fig. 2). Here it is eaten by granivorous birds and probably rodents. (c) The fruit usually remains in the cup where it is visited by ants. Most ants remove the fruits to their nests where they consume the basal elaiosome (Lamont & Grey 1984).

The fruits remain dormant until the soil is disturbed or a fire occurs. Presumably in response to a change in the temperature regime (Brits 1987), most then germinate during the next winter from an average depth of 35 mm. As with banksias, drought probably greatly influences eventual recruitment into the new stand, but this has not been studied directly. Apart from the cotyledons, the foliage is fibrous and probably not very attractive to herbivores. However, there is a specialist phytophagous moth, *Xylorycta* sp., which webs together the terminal leaves. It is preyed upon by a parasitoid wasp, *Campoletis* sp. Seven of 10 xyloryctid pupae we hatched yielded these ichneumonid wasps (Grey & Lamont unpubl).

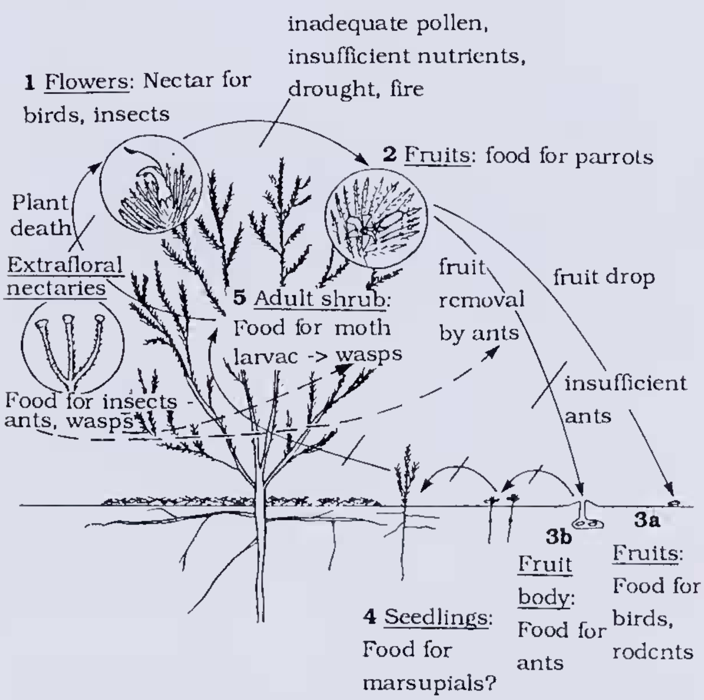

Figure 2 Interactions between *Adenanthos cygnorum* and other components of banksia woodland.

The first leaves of the new season's branchlets in mature shrubs bear extrafloral nectaries on their tips (Fig. 2). Seventeen species of ant, as well as the *Campoletis* sp. and other nectar-seeking insects, visit these glands. The nectaries are a reliable, albeit small, source of sugar for the predatory ants and wasps throughout the year. The location of the elaiosome-bearing fruits and xyloryctid larvae respectively are secondary and irregular events for these insects, but vital in maintaining the fitness of this species. *A. cygnorum* tends to collapse as it senesces and is readily invaded by termites which eventually consume the woody stems after death, before or after fire.

Discussion

There are major obstacles to the completion of one phase and commencement of the next in the life cycle of these two indicator species of banksia woodland. None of the threats to this fine balance as imposed by nature in the past are of the same order as currently caused by wholesale clearing for urban and rural expansion. For the remnants that escape the bulldozer, new obstacles remain, such as fertilizer and herbicide application or drift, weed invasion, *Phytophthora* dieback disease, trampling by hooves and shoes, frequent fire and unprecedented changes in soil water levels. As outlined here, the demise of these two species alone will take with them many dependent animals, to varying degrees. Although the honeyeaters readily switch to new nectar sources, some of the plant-insect relationships outlined here appear to be obligate. From a biological point of view, there is much to commend the conservation of this threatened ecosystem.

References

Brits G J 1987 Germination depth vs. temperature requirements in naturally dispersed seeds of *Leucospermum cordifolium* and *L. cuneiforme* (Proteaceae). S Afr J Bot 53: 119-124.

Cowling R M & Lamont B B 1985 Variation in serotiny of three *Banksia* species along a climatic gradient. Aust J Ecol 10: 345-350.

Cowling R M & Lamont B B 1987 Post-fire recruitment of four co-occurring *Banksia* species. J Appl Ecol 24: 645-658.

Cowling R M, Lamont B B & Pierce S M 1987 Seed bank dynamics of four co-occurring *Banksia* species. J Ecol 75: 289-302.

Lamont B 1986 The significance of proteoid roots in proteas. Acta Horticulturae 185: 163-170.

Lamont B & Grey J 1984 Ants, extrafloral nectaries and elaiosomes on a pioneer species. Proc 4th Int Conf Mediterranean Ecosystems, Botany Dept, Univ W Aust, Nedlands, 89-90.

Lamont B B & van Leeuwen S J 1988 Seed production and mortality in a rare *Banksia* species. J Appl Ecol 25: 551-559.

Nelson E C 1978 A taxonomic revision of the genus *Adenanthos* (Proteaceae). Brunonia 1: 303-406.

Newland C E & Wooller R D 1985 Seasonal changes in a honeyeater assemblage in *Banksia* woodland near Perth, Western Australia. N Z J Zool 12: 631-636.

Ramsay M W 1988 Floret opening in *Banksia menziesii* R.Br.; the importance of nectarivorous birds. Aust J Bot 36: 225-232.

Scott J K 1980 Estimation of the outcrossing rate for *Banksia attenuata* R.Br. and *Banksia menziesii* R.Br. (Proteaceae). Aust J Bot 28: 53-59.

Scott J K 1982 The impact of destructive insects on reproduction in six species of *Banksia* L.f. (Proteaceae). Aust J Zool 30: 901-921.

Taylor A & Hopper S 1988 The Banksia Atlas. Aust Govt Pub Serv, Canberra. 257 pp.

Whelan R J & Main A R 1979 Insect grazing and post-fire plant succession in south-west Australian woodland. Aust J Ecol 4: 387-398.